



Stationary Armor Target (SAT)



RANGE AND TRAINING LAND PROGRAM – MANDATORY CENTER OF EXPERTISE

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General

The Stationary Armor Target (SAT) emplacement is for the installation of a SAT target. There are two sizes of standard emplacements, 14' (4.27m) wide for frontal silhouettes and 28' (8.53m) wide for flank targets. It can support vehicle, dismounted, and low angle aerial gunnery training. By installing different silhouettes on the SAT lifter, the SAT emplacement can represent different threat scenarios to the trainees. Silhouettes include friendly and foe targets; heavy, medium, and light armor vehicles; technical trucks, etc., as well as several types of bunkers. A SAT emplacement can also simulate a breach wall. Most SAT emplacements have a Battle Effects Simulator (BES) installed. The BES is a self-contained unit provided and installed by the target provider; no special design is required.

Range designers should refer to the Inspection Checklists provided in the RDG to ensure that all required items are included in the design.

Civil/Siting

This section covers the Civil Engineering and Siting issues unique to this type of emplacement. Refer to the separate range sections of the RDG for additional siting issues specific to a particular range. See the special sections below for additional information particular to a specific target type.

Emplacement

The standard SAT emplacement uses either a treated timber or concrete gravity block retaining wall on three sides, with a protective earthen berm. Installations may prefer to use other materials, which is acceptable if it is durable, provides protection, and is compatible with the electrical and target equipment. The compacted earth berm provides the protection for the wall and installed equipment from all anticipated directions of fire. The concrete emplacement does not provide significant protection. The floor of the emplacement consists of gravel and a concrete slab. Orient the emplacement toward the anticipated direction of fire.

Mount all permanent electrical and communication boxes on the walls of the emplacement or to a metal slotted channel (Unistrut) structure directly behind the front wall. The target provider anchors the lifter to the concrete slab. See the standard Civil and Electrical detail drawings for additional specific dimensions and details.

Drainage

Ensuring proper drainage is critical in the design and construction of target emplacements. Even though the electrical and target equipment is designed for outdoor installation, many of the issues with range targetry can be avoided with proper emplacement drainage. The ground should slope away from the emplacement whenever possible; add swales as necessary to ensure positive drainage. The floor of the emplacement must slope to the rear. Special care is required in the use of floor and trench drains, as they tend to clog easily and freeze in some climates. Ensure proper compaction under the emplacement to avoid differential settlement. Drainage is especially critical on newly constructed ranges before vegetation is fully established.

Target Clearance

Provide a clear unobstructed area behind the emplacement to allow space for the target in the down position; a minimum of 6.4m (21ft) measured from the face of the emplacement wall.

Configuration

The Civil Details and Electrical Details show the standard SAT emplacement configuration. The emplacement design supports the ballistic characteristics of armor, low-hover helicopters and anti-armor systems. The emplacement does not provide protection from helicopter running and diving fire.

Wall Height

The front wall and berm must be high enough to protect the targetry equipment while still allowing target visibility from the firing position. The minimum front wall height is 1067mm (3ft 6in), 1372mm (4ft 6in) for aerial gunnery. The height has been coordinated within the program as the minimum that hides both the electrical equipment and the targetry based on a relatively flat angle of fire from the shooter to the target, generally ± 2 degrees.

Angle of Fire

The vertical angle of fire (AOF) from the gun barrel to the target is a critical parameter on a range that affects the functionality in several ways. Certain range and weapon types have a limit on the allowable angle of fire, e.g. a Known Distance range limits the AOF to ± 2 degrees. Refer to the installation trainers, applicable training manuals, and the RDG section for specific range types for additional information and guidance. In addition, the amount of the target that is visible to shooters can affect the ability to qualify, i.e. it is harder to hit the target when only half of it is visible. Finally, rounds can hit and damage targetry and electrical equipment on higher angles of fire.

The standard SAT emplacement with a 42-inch front wall and a 2-percent slope on the berm provides adequate protection for AOF of ± 2 degrees. Greater angles require special design consideration. Higher negative angles may require increasing the front wall height, adjusting the slope of the berm to match the AOF, or some other method. Theoretically, the minimum wall height hides the electrical equipment, including the target arms and clamps, up to a -10° AOF, higher with the aviation wall height. In situations with a positive AOF, greater than 2 degrees, the berm itself begins to hide the target. Adjustments to the berm slope may be necessary.

On ranges where target engagement is from multiple points, the designer must coordinate closely with the installation and the targetry provider to determine the correct front wall height. The emplacement protection is also critical for aviation gunnery.

Wall Design

Typical retaining walls are designed using concrete gravity block or wood timbers and steel piles. Design the walls so that the top section is replaceable in case of damage. Filter fabric is normally required. The design of the SAT walls must take in consideration the stability of the wall, including site-specific geotechnical conditions. The design must include overturning, sliding, and settling.

Berm Criteria

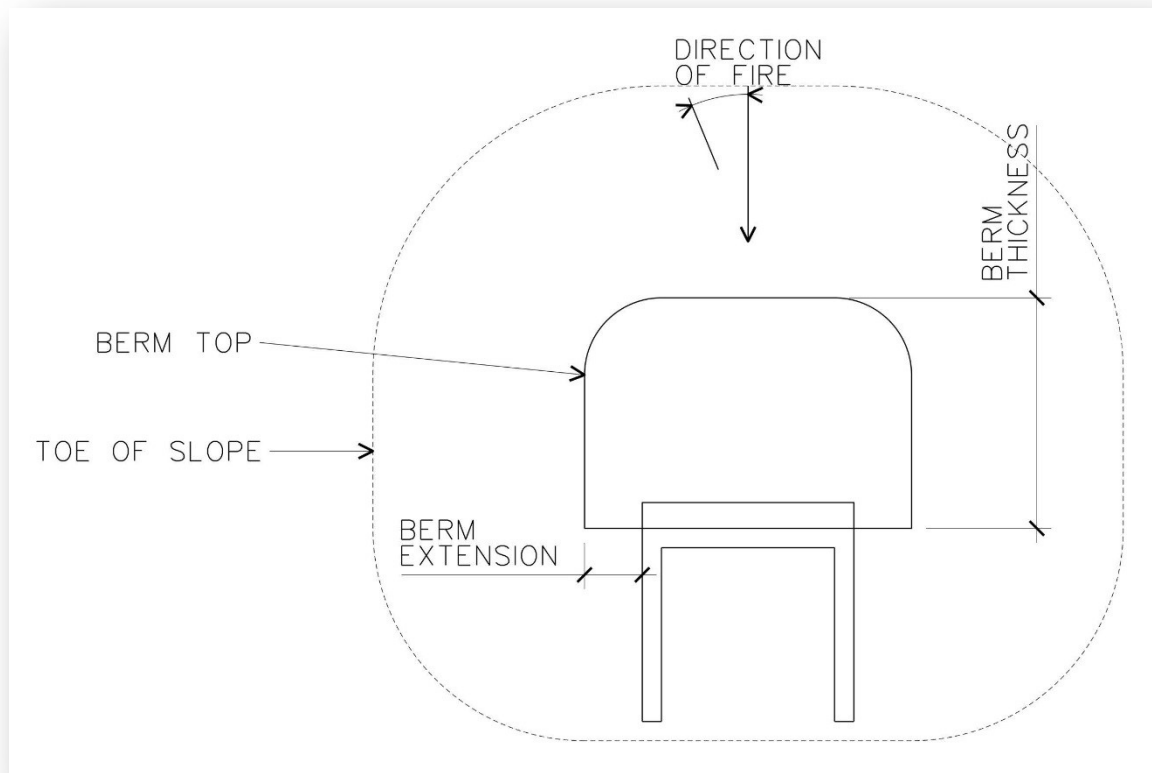
The Target Protection Design Curves, in the Target Protection Section of the RDG, provide the recommended thickness for emplacement protective berms. The curve thicknesses provide protection from many bullet impacts; the amount of soil needed to stop a single round is significantly less. The berm must protect the emplacement from all anticipated directions of fire but is thickest in the expected direction of fire. Use thinner berms to protect the emplacement from occasional directions of fire and ricochets. The standard berm extensions are $\frac{1}{4}$ of the berm thickness; see figure below.

Determine the berm thicknesses based on projectile type, soil compaction, and the in-place soil density. In addition, the designer must coordinate with the range trainer or user to determine the appropriate berm thickness for each target, since individual target siting may dictate added target protection. Design the berm to withstand the largest weapon system that will engage that group of targets. At a minimum, berm widths will be at least 4 feet to facilitate ease of maintenance.

Historical experience shows that, under normal usage, well-compacted berms, designed with the recommended widths require maintenance cycles of 6-months on most range types. Ranges without fixed firing positions and those with lower usage can go much longer between maintenance cycles.

Direction of Fire

The direction of fire (DOF) is the horizontal angle from perpendicular to the target. The standard berm provides full thickness protection for DOF of +/- 20 degrees and adequate protection to +/- 30 degrees or more. Due to SDZ and range safety considerations, it is uncommon to engage targets regularly at larger DOF; coordinate with the RTLP MCX in those cases. The standard berm will protect the electronics and mechanism from errant rounds and ricochets to much higher DOF, up 90 degrees.



SAT EMPLACEMENT (NOT TO SCALE)

Electrical/Communications

This section documents the electrical/communication requirements and equipment installed in a SAT emplacement. It primarily focuses on standard targets with hardwired power and data; a paragraph below has information on battery-operated targets. The Downrange Power & Data Distribution Sections of the RDG describe requirements for downrange power distribution, data networks, transformers, trenching, etc. Use those sections in addition this document to design a complete range. In addition, since some range types have power and data requirements that differ from the standard, refer to the specific range section for details.

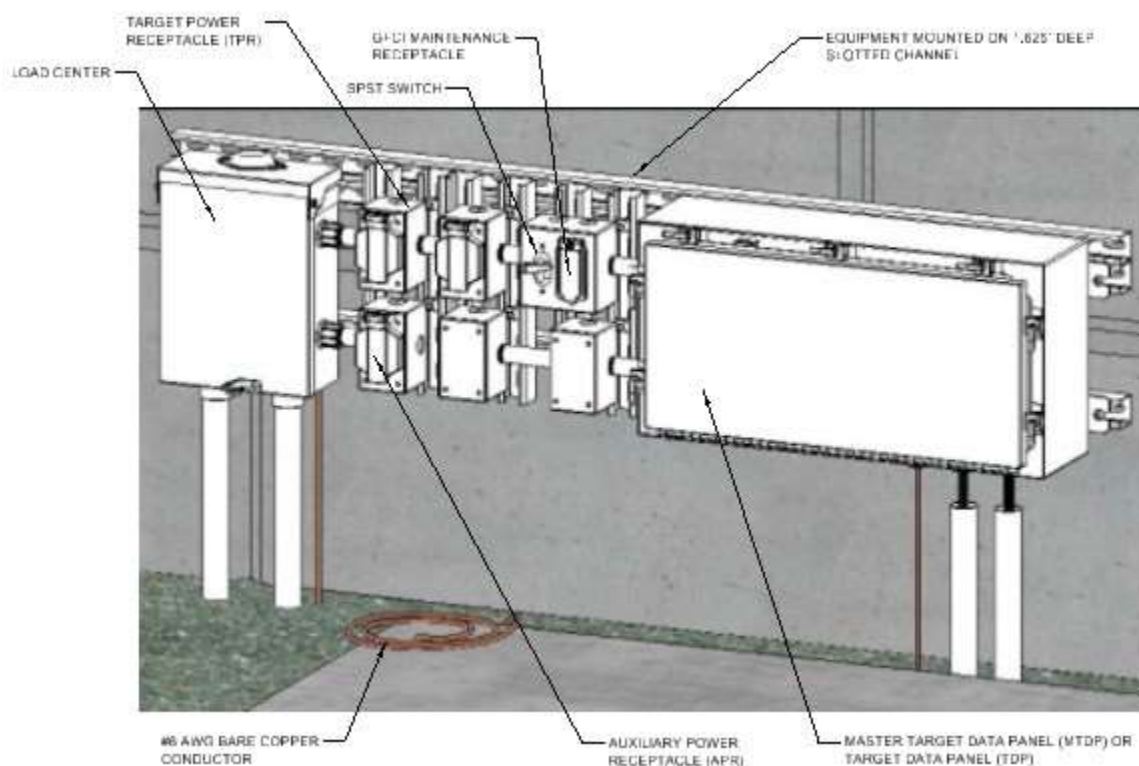
Target Emplacement Wall Configuration

The figure below represents a standard SAT wall configuration. The electrical equipment required in a typical SAT emplacement can include:

- 1) Load Center (LC),
- 2) Target Power Receptacle (TPR),
- 3) Auxiliary Power Receptacle(s) (APR),
- 4) GFCI Maintenance Receptacle (MR), and

5) Data Enclosure (MTDP or TDP).

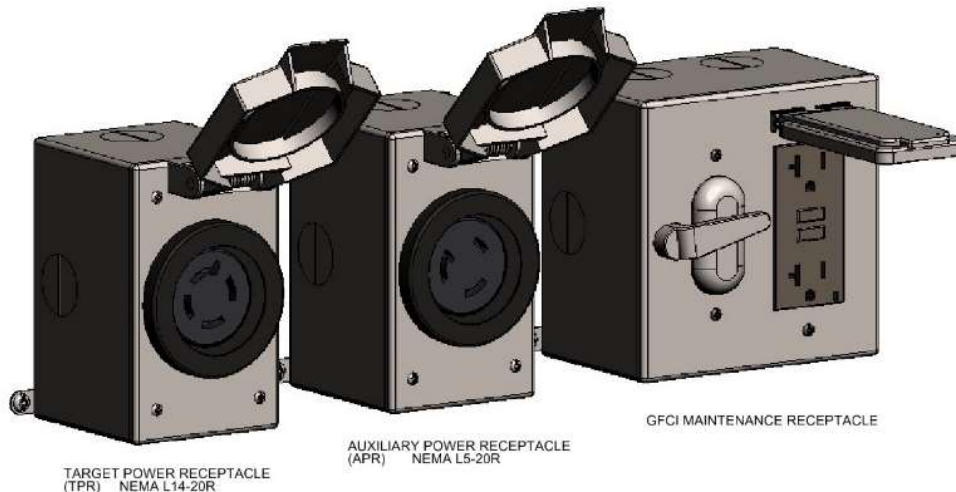
The number and size of the boxes and outlets can vary dependent on the type of SAT and particular range. Mount all boxes and receptacles on slotted strut channel attached to the front wall of the emplacement. **All installed equipment must be a minimum of two inches below the top of the emplacement wall to minimize damage during range use;** preferably lower, see Detail Drawing. The associated wiring and conduits are detailed in other sections of the RDG.



REPRESENTATIVE SAT ELEVATION DRAWING (NOT TO SCALE)

Standard Target Interface

Power is supplied to the target through a cord and plug connection. The target emplacement includes a standard 120/240V **Target Power Receptacle (TPR)**, supplied power via the **Load Center**. There is also a minimum of one - 120V **Auxiliary Power Receptacle (APR)** for additional devices or training aids. Thermal blankets are the most common devices that use this power outlet. Target Power Receptacles and Auxiliary Power Receptacles must be equipped with a waterproof enclosure approved for use with the power plug inserted and unattended, according to NEC 406.8(B) (2). The **GFCI Maintenance Receptacle** is not intended to be used for any unattended devices or training aids. The figure below shows emplacement outlet configurations.



TARGET POWER RECEPTACLES (NOT TO SCALE)

The range data infrastructure consists of data cables installed to the target emplacement and properly terminated inside the target emplacement data enclosures; called the **Master Target Data Panel (MTDP) or Target Data Panel (TDP)**. The MTDP and TDP must be rated NEMA 4, 4X, or 6P depending on environmental conditions. The MTDP/TDP contains the data cable splicing and terminations and the electronics for local target operation. The MTDP and TDP provides space for OPA procured and installed equipment. Target and training device communication is accomplished by this equipment installed inside these data enclosures. The target mechanism installer will connect to the data cables inside these enclosures during the installation of the targets. All networking equipment will be provided with the target mechanism when the target mechanism is purchased. OPA equipment is provided by others and not the MILCON contractor. Refer to the MTDP/TDP details for additional information.

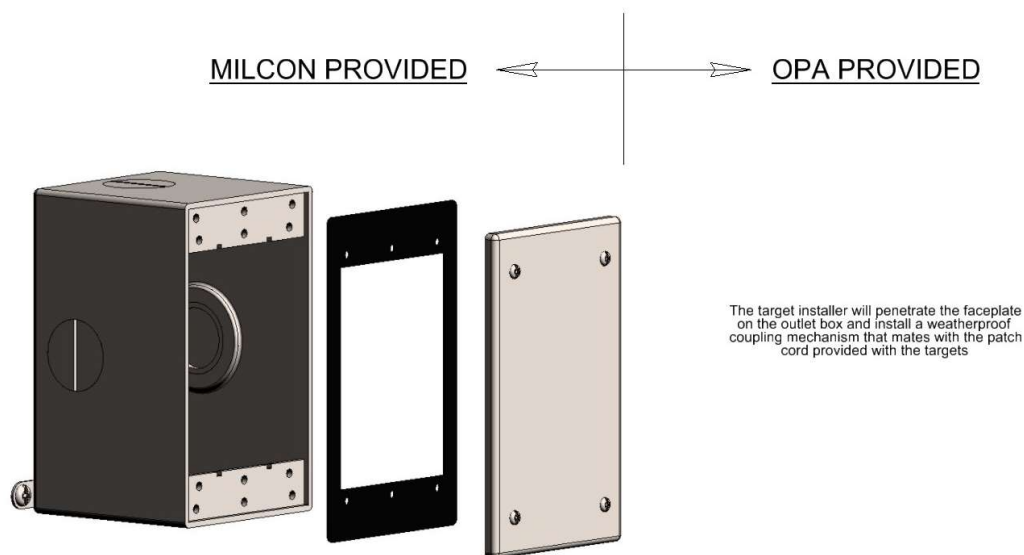
120-volt power is provided in the MTDP/TDP for the OPA installed equipment. The MTDP/TDP and the GFCI maintenance receptacle may utilize the same power circuit, but the MTDP/TDP equipment must be wired ahead to minimize nuisance tripping. 120-volt power is routed through a single pole single throw (SPST) switch adjacent to the MTDP/TDP to allow power to devices installed in the data enclosures to be reset without having to open the NEMA 4 enclosure.

| EMPLACEMENT TYPE | POWER FEED TYPE | PEAK | STATIC LOAD | DESIGN LOAD |
|--------------------------|-------------------------|---|-------------|-------------|
| SAT with Thermal Blanket | 120/240VAC Single Phase | 2kVA While raising or lowering target. Add 1kVA if Thermal Blanket is utilized. | 100VA | 2.8kVA |
| Total Design Load 2.8kVA | | | | |

SAT EMPLACEMENT TARGET POWER TABLE

Target Data Connection

All automated targets are connected to the data cable infrastructure through copper patch cables provided by the target vendor. The interface point between the facility infrastructure and the target installation occurs through the faceplate in the weatherproof outlet box installed immediately adjacent to the MTDP or TDP enclosure. The MILCON installation includes the weatherproof box, sealing gasket, and solid faceplate. The target installer will penetrate the faceplate on the outlet box and install a weatherproof coupling mechanism that mates with the patch cord provided with the targets.



TARGET DATA CONNECTION

Conduit and Cable Fittings

All penetrations into the MTDP or TDP must be made with fittings approved for use with a NEMA 4, 4X or 6P enclosure. Non-compliance with this requirement will result in equipment failure. The standard electrical detail drawings in the RDG illustrate the preferred sealing method. **Foam filled conduits are not acceptable.** The SIT load center only requires a NEMA 3R rated enclosure. Provide fittings approved for use with a NEMA 3R enclosure for connection to the load center.

Routing

All conduits and/or cables should enter and exit from the side or rear of the emplacement. This cable routing helps to minimize damage to the cables from range operations and maintenance crews performing berm repair.

Grounding

Grounding is required for safety at each downrange emplacement or equipment location. Install a 19mm (3/4 in) by 3,050mm (10ft) copper-clad steel ground rod to a depth of 305mm (1 ft) below finished grade at each emplacement or equipment location. Connect the MTDP/TDP and load center equipment to the emplacement's single ground rod with a #6 AWG bare copper conductor using exothermic welded or mechanical connections (where accessible). Bond all data cable armor or shields to the ground bar in the MTDP/TDP. The design includes an 3,048 mm (10') coil of #6 AWG bare copper wire for the target installer to ground the target mechanism.

Surge Suppression

Provide surge protective devices (SPD) in the load center of all target emplacements. The surge suppression for the data communication cables will be provided by the target vendor during the installation of targets.

Environmental Limits

The temperature and humidity limits for electronic equipment are as follows:

- Non-operating and operating temperature: -34°C (-30°F) to 60°C (140°F).
- Humidity: 5% to 95% RH (non-condensing).

